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ABSTRACT

Two major hypotheses were tested in three experiments. The first hypothesis proposed that students can imitate and internalize filmic codes, to be used subsequently as covert schematized mediators. The second hypothesis was that subjects with low relevant aptitude scores would profit more than better able subjects from films which model for them schematic operations to be internalized. The subjects, 80 eighth-graders, were shown two operations--laying out solid objects and zooming in on details--in experimental conditions using either films or slides. Results confirmed that the internalization of schematic filmic codes is possible and leads to improved performance on related transfer tasks and ability tests and that low aptitude subjects, in particular, improved their ability to use the operations as covert mental skills. (JY)

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INTERNALIZATION OF FILMIC SCHEMATIC OPERATIONS IN RELATION TO INDIVIDUAL DIFFERENCES

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Abstract

Two major hypotheses were tested in three experiments. The first hypothesis was that students can imitate and internalize filmic codes, to be used subsequently as covert schematized mediators. The second hypothesis was that Ss, with low relevant aptitude scores profit more from films which model for them schematic operations to be internalized than do better able Ss. Two kinds of operations were either modeled, short-circuited, or not shown at all, thus requiring Ss to activate them on their own. These operations were: zooming-in on details (experiment I & II), and laying-out solid objects (experiment III). Ss were 80 eighth graders in experiments I and II, and 42 ninth graders in experiment III. Results of two of the experiments supported the first major hypothesis, thus showing that internalization of schematic filmic codes is possible and leads to improved performance on related transfer tasks and ability tests. Aptitude Treatment Interactions emerged in all three experiments as expected by the second major hypothesis. It was concluded that filmic modeling of schematic operations can lead to their internalization, improving the ability of low scorers to use the operations as covert mental skills.

INTERNALIZATION OF FILMIC SCHEMATIC OPERATIONS IN RELATION TO INDIVIDUAL DIFFERENCES[1]

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Bruner postulates on a number of occasions (Bruner, 1961; Bruner, Olver & Greenfield, 1966) that communication systems, tools or media, to be effective, must produce appropriate internal counterparts in their users' minds. Berlyne states (1965) that signs appear to have a dual function: they serve both for overt communicational, and for cover representational, purposes. These ideas are far from being new in the realm of language, and much research concerned with language and thought can be cited to support them. Much of the verbal training given to lower class children is based on the assumption that improvements in the communicational capability are internalized and lead therefore to better intellectual functioning (e.g. Blank & Solomon, 1968).

However, the hypothesis that communication codes can be internalized to be used as "mental tools" should not be limited to language. Recent research increasingly shows that non-verbal mediation plays a rather important role in one's intellectual development (e.g., Piaget, 1962), memory (Paivio, 1969; Bugelski, 1970) and problem solving (Arnheim, 1970). Thus, one may wonder whether non-verbal codes can be internalized and used as covert schematic representations; and if they can, how and

under what condition does such learning take place?

There are at least three reasons for posing this question. First, it is a way to put Bruner's hypothesis to an empirical test. Do communication codes "produce appropriate internal counterparts"? What do these consist of, and how are they produced? Second, there is the question of media literacy. There are, no doubt, certain mental processes which need to be mastered to assure appropriate handling of different sources of information, or media. As cross-cultural studies show, (e.g. Salomon, 1968; Feldman, 1971; French, 1963) their acquisition is, at least in part, a function of the amount of exposure to such media. But what function does "exposure" serve? Is it just a question of gradual shaping, or is it as Piaget and Inhelder (1967) imply, a question of assimilating the rules of representation and using them as mental schemata? Third, if non-verbal communication codes <u>are</u> internalizable to be used as cover schemata, then novel objectives for using instructional media can be thought of. That is, the media could be used to serve as a source for the internalization of mental skills, and not merely as vehicles of material information.

A distinction should be drawn between specific visual representations of objects and events, and <u>operational schemas</u>, or <u>codes</u>, through which these specific instances are represented. The distinction is not necessarily one of abstraction, but rather one of <u>generalizability.</u> Negative sentences, slow motion in film, perspective in pictures, etc., are all <u>conventional generalizable operational schemes</u>.

They are operational schemes because (a) they represent certain dynamic relations between entities, or transformations of entities; and (b) they are applicable to a large number of specific instances.

The hypothesis we wished to test is that one learns to use covertly in his representational system, certain operational schemes which he encounters as part of a medium's language of communication. Thus, e.g. we would expect someone to better visualize a "slowed" operation, after intensive exposure to films which model for him "slowed down" movements. Once such a scheme is internalized, it should serve as a mediating mechanism, which facilitates performance in relevant problem situations.

The "internal counterpart" to which Bruner and Berlyne refer would then become exactly that: what is originally a part of a medium's language is now transformed into covert visualization for future use. But how could this process take place? The analogy with language has its limits. Although some imitation may take place in early childhood, the acquisition of language is characterized by interaction with others (e.g. Brown and Bellugi, 1964) and by the fact that the child both encodes and decodes verbal messages. This does not take place in other media where the child serves mainly as a decoder.

Nevertheless, there are several indications that even under such limitations, internalization of communication codes is possible. First, there is the possibility of imitation. Although Bandura

(e.g. 1965) limited himself to studying the imitation of live models, there is no reason why a learner could not imitate inanimate objects and their "behaviors". Piaget (1962) is quite explicit about this possibility and provides empirical observations to support it. The imitation and internalization of operations is, according to him, a major element in the generation of schematic images, and is part of one's developing intelligence. Thus, the fact that one does not use the schema as an encoder, nor interacts with others by means of such a code, may not prevent its internalization.

However, internalization of a code may not always be to one's advantage. Instances in which able subjects were given ready made mediators result very often in interference (Bruner, 1961; Jensen, 1967; Gentile, Kessler & Gentile, 1969). It appears that a code will be internalized and successfully used as a tool for handling new information only when it carries with it some promise for better adaptation. Thus, the code needs to entail a sufficient degree of novelty (Mussinger & Kessen, 1966).

Communication media, and particularly film and TV, have at their disposal a large number of operational schemes which define their "languages". Not all films, and certainly not all instructional films, make use of these schemas. Still, a medium like film may use a large number of schemas which are <u>novel</u> to the extent that they differ from those operations one encounters within the realm of reality (e.g. reversed action). Thus film would be expected to

be capable of modeling novel schemas, leading to their internalization and covert use in new tasks.

The two major questions which we have attempted to answer in the following three experiments were consequently as follows:

(a) To what extent do different degrees of "modeling" an operation by means of filmic conventional schemas lead to their internalization and later covert use with new materials?

(b) To what extent does the learner's initial ability to execute covertly the operation affect his learning from such presentations?

Different amounts of modeling an operation by means of filmic conventional schemas were operationalized as follows:

(a) Maximal modeling: films which represent an operation in detail, such as singling out an item through gradual zooming-in (Experiments I & II), or "laying-out" an object (Experiment III). Here, the whole operation is shown -- starting with the initial situation, going through the operation and ending with the resultant situation. This is labelled the "modeling" (M) condition.

(b) Partial modeling: slides which show only the initial and final situations, short-circuiting the operation itself. This is called the short-circuiting condition (Sc).

(c) Minimal Modeling: only the initial situation is shown. The subjects have to activate and apply the correct operation themselves in order to come up with the final situation. This is called the Activation (A) condition.

The operations selected to be modeled met two criteria:

(a) They were part of the medium's range of operational schemas;

(b) There was reason to believe that these operations, when used covertly, affect one's overt performance.

Experiment I

The filmic code of the "zoom" was selected as a means to study our two major questions: whether it is possible to internalize filmic operational schemas, and if so, by whom. This code was selected for two reasons. First, we have good reason to believe that zooming-in is an analytic process by means of which discrete components of a stimulus are singled out. We also have reason to believe that the zoom has the potential of modeling a covert process of dissociating items from their context. Second, this process, called Cue Attendance, was studied in earlier experiments and found to be modifiable. Moreover, it was found that improvements in Cue Attendance ability affect subjective uncertainty and hence also information seeking behavior (Sieber & Lanzetta, 1966; Salomon & Sieber-Supper, in press). Hence, the choice of using the "zoom" enabled us to model a covert process -- dissociation of items from their context -- while anticipating improvements in this process as well as changes in related behavior known to depend upon it.

Method

Stimuli

The modeling (M) stimulus consisted of three Super-8mm. films. Each of these depicted one of Breughel's Paintings (Children in the Play Ground, Proverbs, and Winter in the Village). The Camera then zoomed-in on randomly sequenced details (such as a child playing, a woman in a window, etc.) and zoomed-out again. This was repeated 80 times in each film. The short circuiting (Sc) stimulus consisted of three series of 81 slides each. In each series a slide depicting one of the three Breughel paintings was shown, followed by 80 slides each of which showed one detail. The singled out details were identical to the ones shown in the M film, with the same random order of presentation and length of exposure. The Activation (A) stimulus consisted only of three slides which showed the same three paintings.

Procedure

Subjects in all stimulus conditions were required to report in writing 80 details they have noticed in each film or slide. This was done for each painting so that each S reached the criterion of reporting 240 details altogether.

Ss in each stimulus condition were seated together in one room, were given an introduction and examples and then worked independently. Once finished with the task, a naive E read S's list of noticed details and if necessary, asked S to replace items which

were inappropriate. Time to criterion varied: Ss in the M and Sc groups worked according to the speed determined by the presentations; Ss in the A group worked as long as needed and the slide was projected until the last of the Ss finished his task. A fourth condition -- a pre- and posttest only control group, did not view any of the above stimuli.

Subjects

80 eighth graders, all from one school, participated in the study. They were randomly assigned to four groups (n=20): M, Sc, A, and a pre- and posttest only control group. There was an equal number of males and females in all groups.

Measures

All Ss were administered a Cue-Attendance aptitude pretest (CA-pre)[3] one week prior to the experiment. The test was based on a rather complex visual slide (actually a random montage of items). Subjects were asked to report in writing the maximum number of items they could notice. There was a time limit of seven minutes.

There were two post-training tests administered after the third experimental session, as follows: (a) A Cue Attendance posttest which resembled in structure and requirements the CA-pre, but differed in content (CA-pt). (b) A test of Information Seeking behavior (IS). Ss were read a problem with six equally appealing solutions. Before answering, they were permitted to seek additional information which was written on cards contained in 30 sealed envelopes.

These could be opened by S, if wished. However, there was a loss of one point, out of 30 points initially given to each S, for each opened envelope. The measure obtained was the number of opened envelopes divided by the score of certitude that each S attached to his final solution. The latter ranged on a seven points scale from complete certainty that the selected solution is "right", to complete uncertainty. Thus the number of opened envelopes was weighted, taking into account one's reported certitude.

Results

As can be seen in Table 1, all four groups had quite similar scores on CA-pre. However, significant differences between their Ca-pt and IS scores were found ($F = 4.52$ and 4.15 respectively, $p < .05$, one way ANOVA). All three experimental groups reported noticing significantly more items on the Ca-pt than the control group; the same groups also received significantly higher IS scores than the control group. These findings are not surprising in light of previous studies, cited above, in which it was found that training on cue attendance improves CA and IS behavior.

TABLE 1 ABOUT HERE

More interesting is the fact that the M group improved, relative to the control group, as much as the A group, and that

both improved significantly more than the Sc group (Scheffe post-hoc comparison).

There was a second question that needed to be answered concerning the differential effect of the treatments on Ss. Here the aptitude-treatment-interaction paradigm (Cronbach & Snow, 1970) was used. CA-pt and IS scores were regressed on CA-pre scores separately for each group, and the slopes of the lines compared with each other (Table 2).

TABLE 2 ABOUT HERE

The analyses revealed significant disordinal interactions between those conditions which called upon the S's own supply of the mediating process (conditions A & Sc) and the modeling condition ($F = 3.08$, $P < .05$).

Since the two posttests correlated positively with each other (in the M group $r = .45$, Sc group $r = .48$, A group $r = .48$, control group $r = .51$) it is clear why these interactions appeared on both posttests (figures 1a and 1b).

FIGURES 1a & 1b ABOUT HERE

While initially poor CA scorers appeared to have benefited relatively little from the Sc, A and control conditions, they

seem to have profitted far more from the M condition. At the same time, the M condition depressed the performance of initially high Ca scorers, relative to what such Ss had learned from the Sc or A conditions.

Thus, in agreement with expectations, those Ss who did not initially dissociate items from their contexts, upon seeing the operation modeled in front of their eyes, gained significantly in performance. They did not learn as much, and actually far less, when they were given training conditions which called upon the covert activation of the same operation. The reversed effect can be observed with those who initially mastered well the operation. Whether this is a case of interference or not, however, remains an open question.

Discussion

The results of this experiment lend tentative support to the two major hypotheses: (a) A filmic operational scheme, in this case zooming-in and out, is learnable; it can be used covertly in a similar task with new material (the CA-Posttest), as well as in a rather remote, though psychologically related task (the IS measure). (b) There is a negative relationship between "spoon feeding" the scheme (that is, the visual presentation of the operation), and the learner's initial ability to execute it covertly on his own. The less able he is, the more he profits from such modeling.

There is one rival hypothesis which may account for the post-test performance of the Ss in the experiment. Although both M and Sc Ss saw the same details, only the M group saw the whole painting after each act of zooming-in on a detail. The Sc group saw the whole painting only once. Thus, it could be claimed that whatever posttest differences existed between the two groups, amount of information, rather than the modeling of the process, may have accounted for them. However, this rival hypothesis does not seem to be very plausible. First, there are no theoretical grounds to claim that viewing more often the whole stimulus should lead to better performance in cue-attendance or information seeking behavior. Second, should the hypothesis be correct, then the A group, which received even less information, would perform less well than the Sc group. This however was not the case.

Although results were as expected, there is nothing in the data to suggest how the learning takes place when one "internalizes" a filmic operational scheme. If it is imitation then it should not be limited to only one scheme, given that our films use at the same time other operational schemas as well. For instance, the order in which details are singled out is such an additional scheme, and Ss would be expected to imitate it as well. Secondly, if it is not simple visual imitation, and the learning is mediated by internal verbalization, then induced verbalization should lead to even more improvements. Experiment II was designed to replicate experiment I, and to shed light on the above questions.

Experiment II

This experiment partially replicated the former one. However, one experimental variable was added, namely: Induced overt labeling of the items singled out by the camera (M condition) or by the subject himself (A condition). It was reasoned, following Kendler & Kendler (1968) that if verbalization plays a mediating role in learning from an M film, then induced labeling should improve post-training performance. Low verbal ability Ss were expected to gain more from such labeling than more verbally able Ss who apparently are more likely to use verbal mediation on their own anyway (e.g. Jensen, 1967). However, if this kind of learning does not rely upon verbal mediation, then, it was reasoned, induced verbalization would have no effect on learning.

In the present experiment the Sc condition was dropped leaving only the M and A conditions. These are the two extreme ends of the continuum of modeling a covert skill through the use of filmic operational schemas. This resulted in a 2 (M vs. A) x 2 (verbalization vs. no verbalization) factorial design.

Method

Stimuli

There were two stimulus conditions which were identical to M and A conditions of the previous experiments. Half the Ss saw the film which modeled the operation of singling out details from a noisy

display, using the zooming in technique (M condition). The other half saw three slides of these paintings on which the films were based (A condition).

Procedures

There were four treatment groups. The Modeling-Verbalization Group (MV): Ss saw the three modeling films. While viewing them, each S was randomly called upon to label aloud the detail on which the camera was then zooming-in. Ss saw the films in groups of seven (half the size of the group). It was assumed that all Ss were busy labeling the details to themselves, since no one could know whose turn it will be next to label aloud. The criterion to be reached by each sub-group of seven Ss was 42 labeled details per film (6 reported details per S). The whole training period lasted for about three hours. The Modeling-non-verbalization Group (MNV): Ss were run in the same fashion as above with the exclusion of verbalization. No verbal responses were required, and no reinforcements by E were given. Ss were told to "notice what exactly the camera does and to note to themselves the details they observe". The films and the criterion were the same (criterion was actually set by the number of zooming-ins per film). The Activation-Verbalization Group (AV): Same procedure as in the MV group was maintained. However, instead of being exposed to the M film which singled out details for the Ss, there was a static slide and Ss had to report noticing the same number of details

from the slide, as in group MV. The Activation-Non Verbalization Group (ANV): This group served actually as a control group since all it did was get the same instructions as the other groups, but watch in silence the static slides. Instructions were those given to the MNV group. This is also the only group which was not lead to reach the training criterion.

Subjects

56 eighth graders were randomly chosen from two classrooms. These were then randomly assigned to the four groups (N=14). Within each group the 14 Ss were again randomly divided into two sub-groups of seven each. This was the unit with which E's worked.

Measures

The number of aptitude and post-training measures was increased from experiment I. There were three pretest aptitude measures administered in a random order one day prior to experimentation.

(a) A CA pretest (CA-pre), very similar in nature and requirement to the CA tests used in the previous experiment.

(b) Witkin's Embedded Figures Test (French, Ekstrom & Price, 1963).

(c) An Israeli Standardized Verbal ability test (MILTA), for which norms based on national samples are available.

The posttest measures, administered in a random order one day following the end of experimentation, were as follows:

(a) A CA posttest (CA-pt), which was based, like the previous CA tests, on a complex and rich visual display, from which Ss had to single out details and report them in writing.

Two measures were obtained from this test:

(i) Number of reported details;

(ii) A mean organization score which indicated the extent to which details were reported in some spatial order. Whenever S reported noticing a detail which was spatially adjacent to a preceding reported detail, he received one point. Thus, the maximum score any S could receive was $\frac{n-1}{n} \cdot (100)$. Ss were not told to report details in any order, nor was the question of order mentioned.

(b) An Information Search test which was as follows: Ss were shown a projected map of an hypothetical Island. They were told that two tribes there engaged in war and the Ss were to determine the reasons for it. They were permitted to go through a booklet each page of which had one specified informational item. The pages were stapled on both sides of the booklet so that S had to tear the pages open. On each page S opened, there was a four point scale on which S had to indicate how important that specific informational item was for him. Once finished, S had to choose an answer out of six alternatives. The measures extracted from the test were: (i) Number of pages S tore open (IS); (ii) The square mean difference between ratings of importance attached to each information item (D). This was assumed to be a fair measure of one's ability to differentiate between items of information he processed.

Results

The means and standard deviations of all measures for each group are given in Table 3. As it can be seen, MV Ss performed a bit better than control (ANV) Ss with the MNV and AV Ss falling somewhere in between.

TABLE 3 ABOUT HERE

However, 2x2 ANOVAS failed to produce statistically significant F ratios for either one of the two main effects or the interactions between them although differences between the M and A groups were in the expected direction. The only exception was with regard to the measure of differentiation (D), where the M Ss were found to receive a significantly higher score than the A Ss ($F=14.0$, $P < .001$). The failure to detect significant differences due to the M treatments disagrees with the results of experiment I, although the ages of Ss in the two experiments were very similar, and the stimuli were identical. The only major difference between the two experiments was in the level of training criterion that each S had to reach individually. In experiment I each S had to report in writing noticing 80 details per film (or slide) and 240 details altogether. In experiment II the individual criterion was only six verbally reported details per film (or slide), and 18 altogether, per subject.

Thus, it would be reasonable to postulate that in experiment II, criterion to be reached was apparently far too low to produce any observable difference which reaches the needed level of significance.

No significant differences among group means do not rule out, however, possible Aptitude Treatment Interactions (ATI's). To detect such ATI's posttest scores were regressed on aptitude scores for each group. The intercorrelations between the measures are given in Table 4.

TABLE 4 ABOUT HERE

As in experiment I, there is a significant ATI between treatments and initial CA aptitude scores (Figure 2a; $F=6.12$, $p < .05$). Ss who were initially poorer cue-attenders appeared to profit more from a treatment that provided them with a visual model of the schematic operation which they had to execute. On the other hand, better skilled Ss appeared to display poorer performance following such a treatment. The exact opposite occurred following the A treatments, in which Ss had to activate the operation on their own. This time, however, the ATI is observed when differentiation, rather than CA-post-training scores is the dependent variable. A differential predictor of post-training CA performance is one's verbal ability (MILTA), as can be seen in Figure 2b.

FIGURES 2a & 2b ABOUT HERE

Again, the slopes of the regression lines differ significantly ($F = 4.84$; $p < .05$). As before, low aptitude scorers profit more from the M conditions while high scorers profit more from the A conditions. Since the overall correlation between MILTA and CA-pre is .474, the two ATI's seem to be somewhat redundant.

A similar pattern emerged when organization scores were regressed on MILTA or EFT aptitude scores (overall correlation between the two is .692), as shown in figures 3a and 3b ($F = 5.16$ and $F = 5.62$, respectively, $p < .05$). The interesting point to note is that low MILTA or low EFT scorers, scanned the visual field in a much less organized way, following the M treatments, than similarly low aptituders following the A conditions. On the other hand, low scorers on the two aptitude tests, who were not exposed to the model

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FIGURES 3a & 3b ABOUT HERE

(which, as it will be recalled displayed a random order of zooming-in on details)showed better organization in their scanning, which did not differ significantly from that of the high aptituders. It should also be noted that high aptituders scanned the field in a much better organized fashion following the M conditions than those high aptituders in the A conditions.

Whether this shows some kind of overcompensation on the side of the latter Ss in face of the unorganized model, remains an open question.

It is the case, however, that high MILTA scorers, following the M conditions, noticed significantly fewer details (as measured by the CA-pt) than high MILTA scorers who were exposed to the A conditions. Comparing CA-pt performance of the ten highest scorers on MILTA within the M conditions, with the ten highest MILTA scorers in the A conditions shows that the latter perform better than the former ($t = 1.8$; $df = 18$; $p < .10$). The opposite occurs when we compare the organization scores of these two sub-groups ($t = 2.01$, $df = 18$, $p < .05$). Thus, it appears that when exposed to a model which (a) shows an operation with which these Ss are familiar, and (b) which displays another operation (random order of scanning) which apparently disagrees with their more orderly style, these Ss put more energy into imposing structure on their responses than into producing a large number of such. Therefore their organization scores correlate highly with general ability, when in the M conditions (.7 with MILTA and .72 with EFT), and not at all with their post training CA ability (-.08). The exact opposite pattern takes place in the A conditions (see Table 4).

Discussion

In general then, apparently due to too low training criteria, no clear effects of either modeling the schematic operation or of induced verbalization were found. The assumption that all Ss in the vergalization groups engage in spontaneous labeling, while

expecting to be called upon by E, appears to be questionable. It is more likely that the low verbal ability Ss engage in labeling only after being called upon. Therefore, the criterion of 18 labels they had to provide was far too low for them. On the other hand, the ATI's show that learning - in terms of internalization of the modeled schematic operation - takes place. However, this is restricted to the low aptitude scorers, while the high scorers either experience interference, or try to rely on their high general ability to overcome the disagreement between their behavioral patterns and the ones "spoon fed" to them. What the ATI's with MILTA as predictor suggest is that some Ss (particularly low verbal ability scorers) imitate the visual schematic operation quite directly, something that is seen in the number of details they report, their improved differentiation, and the reduced organization of their responses. Other Ss, the more verbally able ones, do not just imitate the visual schematic operation but internalize it through verbal mediation. This in turn causes them to produce fewer responses, but to better chunk and organize them. Experiment III was partly designed to shed more light on this question. It was hypothesized that if verbally better able Ss do impose logic on the operation they internalize then their learning should not be debilitated. This, however, requires one necessary condition, namely, that the schematic operation to be internalized can be executed by means of logical operations and not only by means of dynamic images, as is apparently the case with the zoom-in operation.

Experiment III

In this experiment we returned to the design of Experiment I, leaving out only the Activation condition, and choosing to model and short circuit an operation which is far more novel to Ss than the one modeled before. The schematic operation modeled here was that of "laying out" solid objects. This again is an operation which is within the filmic range of schematized operations and which at the same time resembles a covert process in use when certain "visualization" problems (e.g., in learning geometry) are encountered. Thurstone and Guilford designed measures of one's mastery of this operation such as the Paper Folding Test, Surface Development Test and the Form Board Test (French, et al. 1963). This operation can however be executed also along logical lines, instead of as an act of vivid visualization.

The hypotheses of the present experiment were as follows: (a) That students can and do internalize the visually modeled scheme of "laying out" solid objects shown on the screen, as can be observed in their improved scores on visualization tests; (b) that verbally able Ss, who can be assumed to rely more on logical manipulations rather than on internal visualizations, would profit as much as less verbally able Ss from such modeling, yet using another kind of mediation (logic) than the latter Ss.

Method

Stimuli

There were two modeling conditions: M and Sc. The M stimuli consisted of a 15 minute film in which 5 solid objects appeared and then gradually were layed out, side after side. Once an object was layed out it gradually folded up again. The Sc stimuli consisted of a series of 10 slides (five pairs). The first slide in a pair showed the solid object while the subsequent member of the pair displayed the same object in a layed out position.

Procedures

There were three experimental groups: One M, one Sc and one control group. The M group was given a general introduction and then shown the film once. It saw the same film again on the next day and a third time on the third day. No responses were required. The Sc group received the same treatment but with the slides instead of the film. The control group served as a pre- and posttest only group. No treatment was given.

Subjects

The Ss were 42 ninth grade students in a vocational school. All Ss were males. They were randomly assigned to the three groups (n=14).

Measures

Three pretest measures were taken: (a) Visualization ability, measured by the Paper Folding Test designed by Thurstone (French, et al.

1963); (b) the S's average grade in language studies; (c) the S's average grade in mathematics. There was only one post-training measure, namely a test of visualization ability, as measured by Thurstone's Surface Development Test.

Results and Discussion

Although assignment to groups was random, one way ANOVA revealed significant differences between mean pretest visualization scores of the groups ($F = 3.52$; $df. = 3.39$; $p < .05$)

Since, however, pretest visualization scores correlated positively with posttest visualization scores in all groups, and since linear requirements were met, analysis of covariance was used. The Scheffe post hoc comparison showed that the mean posttest visualization scores of group M was significantly higher than that of the Sc group, and that both means were significantly higher than that of the control group (Table 5). Thus, the results appear to be in agreement with those of Experiment I. When

TABLE 5 ABOUT HERE

correlational analyses were done (Table 6) an ATI emerged between the Ss' grades in the language studies and their posttest visualization scores (Figure 4). In the control group, Ss with higher

TABLE 6 ABOUT HERE

language scores performed better on the visualization test than low scorers (t ratio for the regression slope is 2.8, df = 12, $p < .05$). In the M group the reverse takes place (difference between the two regression slopes: $F = 4.35$; df = 1;24; $p < .05$). The slope of the Sc group is negligible and can be regarded as not differing from zero. Visual modeling of the operation facilitated learning of the less verbally able Ss more than of the better able ones. If the latter Ss did impose logic on the operation, as we thought they did, then their posttest performance should not have been this low. It is, however, possible that the operation of laying-out objects does not yield to logic, and has to be executed as a schematized covert visual image. In that case verbally able Ss would try, in vain, to utilize logic. Hence, the little benefit they had from the modeling condition. In essence, then, the results in the present experiment further strengthen the previously obtained ones. They add also to the credibility of our hypothesis that highly verbal Ss have difficulties internalizing a visual model of a schematized operation relative to the less verbal Ss.

General Discussion

The three experiments have shown that improvements in two kinds of covert skills can take place as a result of training with films which model those operations, and that this has a clear transfer effect.

Further, it was found that some Ss, notably those with poor relevant aptitude scores, profit more from such modeling, while those with high scores are hindered in their performance. The latter Ss profit more when not "spoon fed", i.e. when asked to execute the operation covertly on their own. It was also observed that vicarious learning, in the sense that a S executes covertly a response while another S verbalizes it (Experiment II), is not the same as when he himself has to act out the response (Experiment I). Hence, when training criterion is lowered, learning from a visual model is reduced. Finally, the hypothesis that some Ss are better off internalizing the model through verbal mediation, received indirect support.

However, one may wonder whether all that has been shown here is perhaps no more than another case of learning from visual displays. This, obviously, is not very novel in light of what both daily experience and research have repeatedly shown. Gagne & Gropper (1965), Gropper (1970), and Travers (1970), to mention only a few, have repeatedly shown that learning from visual displays is not only possible, but even relatively more powerful than verbal instruction. Also the presence of ATI's, although infrequently studied, carries with it little novelty (see Snow & Salomon, 1968, for a general rationale).

There is however a major and very essential difference between the usual kind of studies dealing with visually based instruction, and the ones reported here. Clearly, the operations displayed on the

screen by us can not be termed "signs" or "symbols" since they do not serve as completely arbitrary representations of operations, but are the operations themselves. In this respect they are iconic representations, in the sense that we assume that they have something in common with the covert operations which they "externalize". That is, one can assume that they resemble the operations that the learners should have, or actually do, execute covertly. The operations utilized here are not analogous to grammatical forms used in language, or to verbal concepts. Nevertheless, they differ markedly from the usual information displayed in films or slides. It was not the details of Breughel's paintings, nor the structure of the solid objects, which was to be learned from them, but rather the schematic operations of singling out details or laying out solid objects. Moreover, the question we posed was not whether visual information is better for instructional purpose than verbal information, or whether "spoon feeding" is better than "autonomous" learning. The question was whether such schematic operations as sampled here, which are part of a medium's unique range of communication codes, are internalizable as schematic operations, and hence used as covert schemes.

One may ask whether exposure to media, such as print, film, TV and the like leads to the development of new covert representational systems, as McLuhan (1965) or Bruner et. al. (1966) claim. This we hypothesized, is a matter of internalizing the codes, conventions, and schematic ways of representing something, which are unique to media,

and their covert use as part of one's representational system. The experiments reported here were a first attempt at studying whether such internalization is at all possible, and if so, by whom.

The internalization of operations and their use in a representational capacity is an important issue in Piaget's theory. However, he strongly emphasizes the importance of manipulatory learning rather than observational learning. Nevertheless, while discussing imitation (piaget, 1962), observation of operations appears to play as important a role in his theorizing as manipulation. But this may not be an all-or-none question. Logical operations, of the kind studied by Piaget, may be learned solely by manipulation (Wholwill, 1970). Not so with other operations which like the ones studied by us, do not follow necessarily any agreed-upon logic, but are rather conventional schemes.

Educationally speaking, what our studies hint at is that certain mental skills may be adopted from communication media and thus expand one's range of covert skills. The question then is not whether this is a "better" mode of instruction, but whether one can use visual media not just to acquire "knowledge that" but also "knowledge how to", particularly to those learners who appear to have difficulties with other and more common types of instruction.

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TABLE 1

Means and Standard Deviations of Pre- and Posttests for all Groups

Group	CA Pretest		CA Posttest		IS	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Modeling (M)	13.12	6.9	31.3^{c}	8.60	2.9^{c}	1.10
Short Circuiting (Sc)	11.45	6.07	25.1^{b}	7.40	2.3^{b}	1.68
Activation (A)	13.05	4.17	32.8^{c}	9.95	3.2^{c}	1.11
Control	12.70	6.65	16.7^{a}	6.5	1.9^{a}	1.10

Note: Means which are significantly different from each other ($p < .05$) have different superscripts.

TABLE 2

Linear Regression Coefficients of Posttests

Predicted from Pretests for all Groups

Group	CA-Posttest Predicted from CA Pretest			IS Posttest Predicted from CA Pretest		
	r	b coefficient	t	r	b coefficient	t
Modeling (M)	-.46	-.572	2.21*	-.630	-.103	2.16*
Short Circuiting (Sc)	.28	.341	1.22	.367	.147	1.66
Activation (A)	.52	1.24	2.78**	.744	.136	4.70**
Control	.48	.469	2.50*	.617	.102	3.34**

* $p < .05$

** $p < .01$

TABLE 3

Means and Standard Deviations

for Each Group

Measure		Group MV	MNV	AV	ANV
MILTA	$\bar{X}$	92.8	92.7	87.4	89.1
	SD	13.9	12.8	10.7	11.9
EFT	$\bar{X}$	6.5	6.5	6.8	6.5
	SD	4.7	4.5	4.0	3.2
CA-Pre	$\bar{X}$	50.9	48.6	48.8	50.9
	SD	10.9	9.6	9.5	10.8
CA-pt	$\bar{X}$	35.9	34.0	33.7	32.6
(Number)	SD	2.7	6.2	6.3	6.5
CA-pt	$\bar{X}$	36.2	37.5	35.3	33.7
(Organization)	SD	15.4	18.7	17.8	10.2
IS	$\bar{X}$	25.8	25.0	24.3	23.6
	SD	8.0	9.6	8.7	9.0
D	$\bar{X}$	2.4	2.3	1.9	1.5
	SD	0.96	0.72	1.0	1.0

TABLE 4

Intercorrelations Between Measures Separately for Each Group

		1 MILTA	2 EFT	3 CA-PRE	4 CA-POST (Number)	5 CA-POST (Organization)	6 IS	7 D
1	MV	-	.875**	.560*	.271	.605*	-.214	.085
	MNV	-	,528*	.552*	-.180	.800*	-.457	.228
	AV	-	.531*	.523*	.730*	.153	-.100	.228
	ANV	-	.653*	.630*	.580*	-.063	-.387	.204
2	MV		-	.271	.334	.686*	-.389	.194
	MNV		-	.355	-.088	.516*	-.287	-.149
	AV		-	.266	.384	.073	-.202	.128
	ANV		-	.377	.377	-.273	-.403	.277
3	MV		-	.403	.356	-.334	-.583*	
	MNV		-	.007	.372	-.259	-.374	
	AV		-	.411	.145	-.155	.125	
	ANV		-	.549*	.311	-.370	.364	
4	MV			-	-.108	-.396	-.215	
	MNV			-	-.082	.100	.242	
	AV			-	.453	.399	.350	
	ANV			-	.566*	-.152	.381	
5	MV				-	.079	-.247	
	MNV				-	-.223	.135	
	AV				-	.615*	.263	
	ANV				-	.238	.441	
6	MV					-	.103	
	MNV					-	-.400	
	AV					-	-.118	
	ANV					-	.361	

Note: n = 14 in each group. * $p < .05$

** $p < .01$

TABLE 5

Means and Standard Deviations for Each Group

Group	Visualization (pretest)		Language Studies		Mathematics		Visualization (posttest)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
M	62.6^{a}	14.9	6.0^{a}	.59	6.0^{a}	.8	68.0^{c}	9.5
Sc	62.2^{a}	11.4	6.3^{a}	.68	6.1^{a}	1.4	63.5^{b}	16.7
Control	71.4^{b}	13.7	6.0^{a}	.79	5.6^{a}	1.0	57.0^{a}	25.5

Note: Means which differ significantly from each other ($p < .05$) have different superscripts.

TABLE 6

Intercorrelations Between Measures for Each Group

		1 Visualization Pretest (Paper Folding Test)	2 Language Grades	3 Mathematics Grades	4 Visualization Posttest (Surface Dev.)
1	M	-	.54*	.41	.29
	Sc	-	.20	.24	.35
	Control	-	.30	.13	.31
2	M	-	-	.12	-.36
	Sc	-	-	.44	-.19
	Control	-	-	.14	.63*
3	M	-	-	-	.38
	Sc	-	-	-	.21
	Control	-	-	-	.28

Note: N = 14 in each group

* $p < .05$

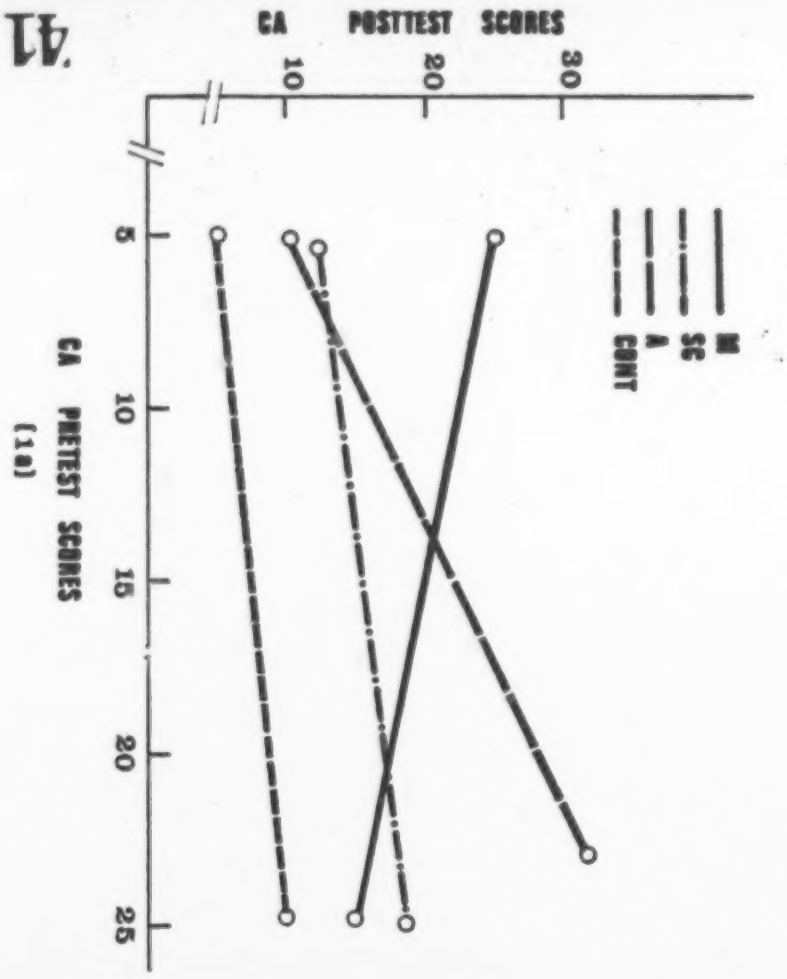
Figure Captions

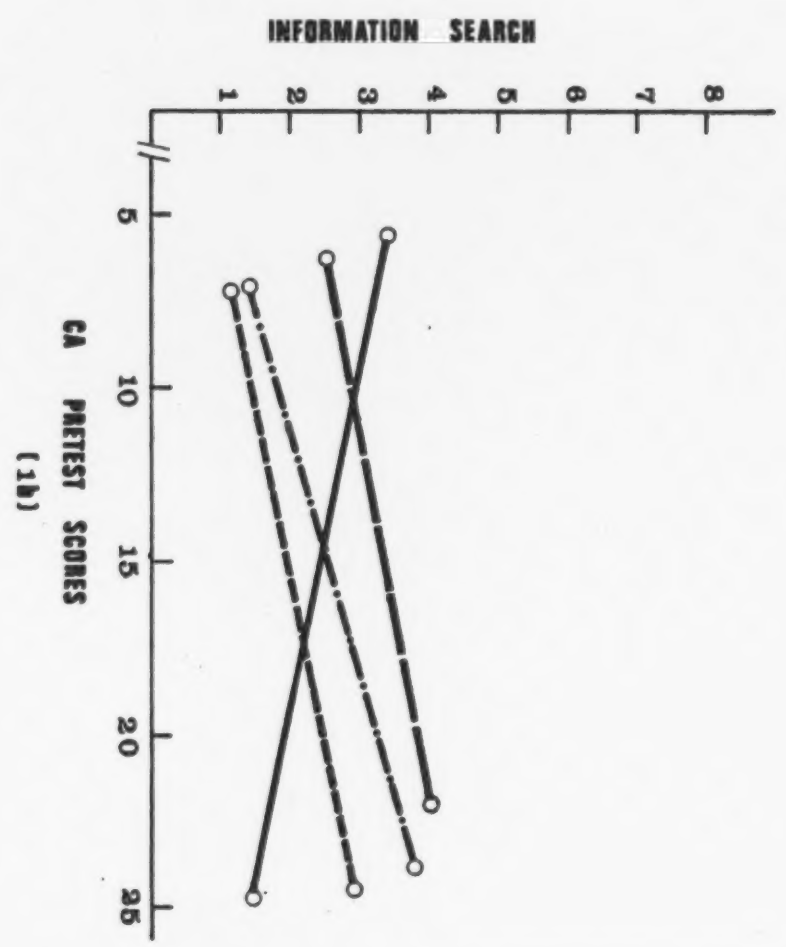
Figure 1: CA-pt (1a) and IS (1b) scores regressed on CA Aptitude Scores, for each group.

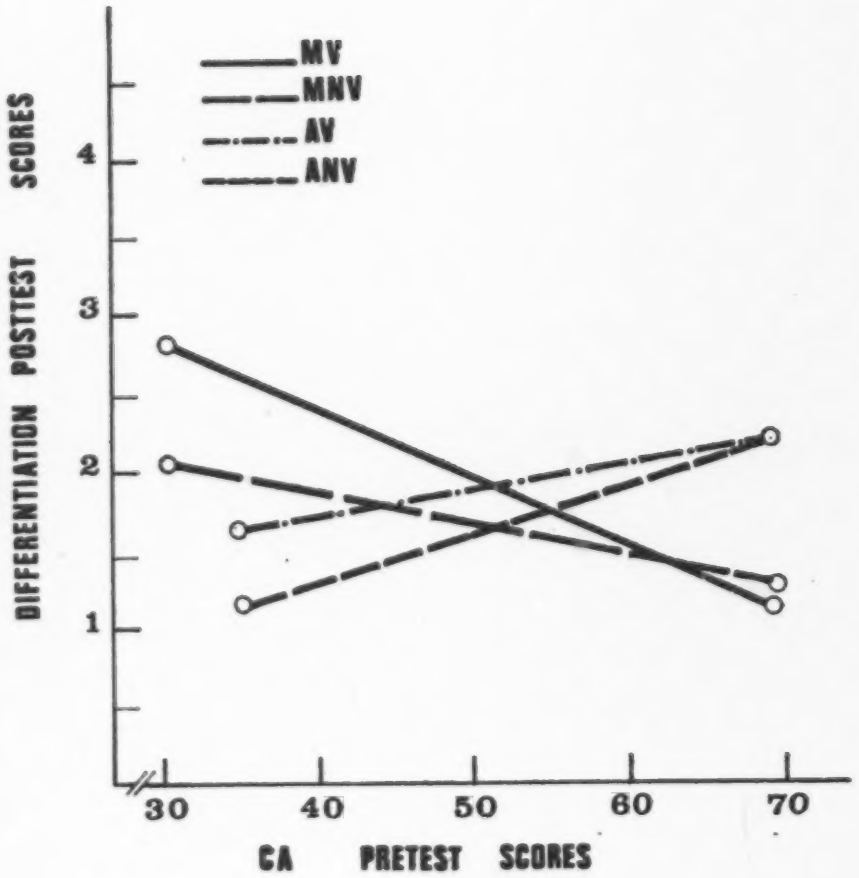
Figure 2: D scores regressed on CA Aptitude Scores (2a) and CA-pt scores regressed on MILTA scores (2b), for each group.

Figure 3: Organization Scores regressed on MILTA (3a) and on EFT scores (3b), for each group.

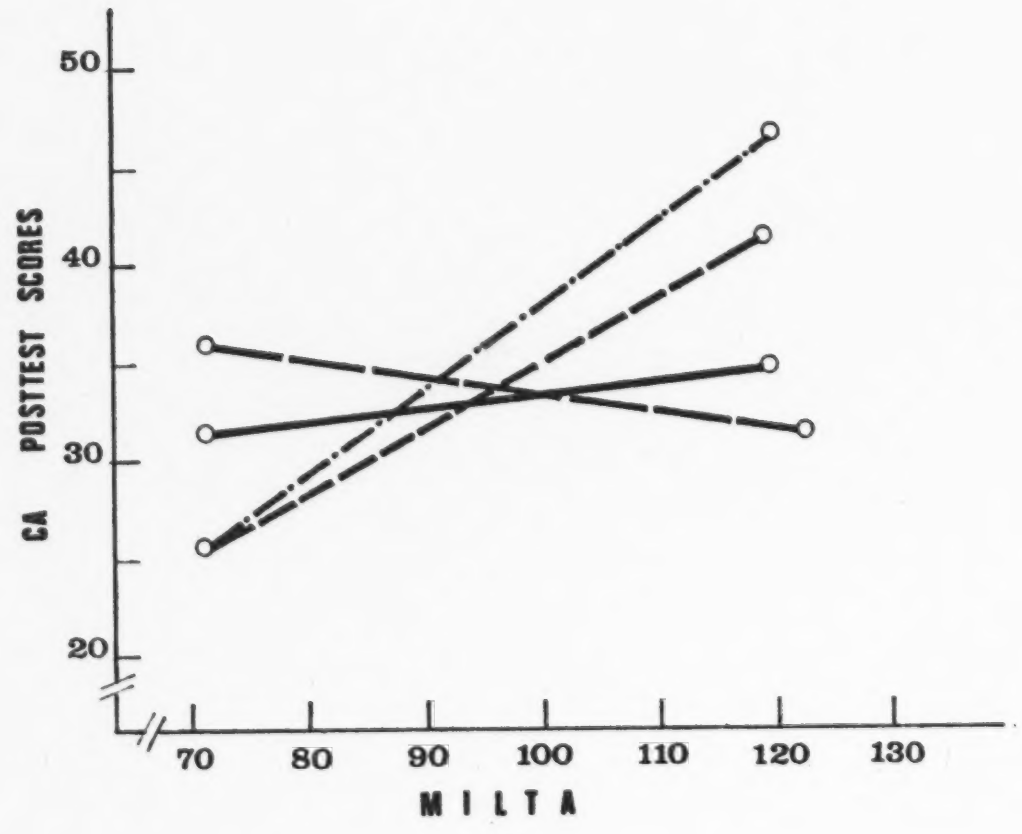
Figure 4: Visualization Ability posttest scores regressed on language grades for each group.


CA POSTTEST SCORES
10
20
30
MI
SS
A
CONT
5
10
15
20
25
CA PRETEST SCORES
(1a)

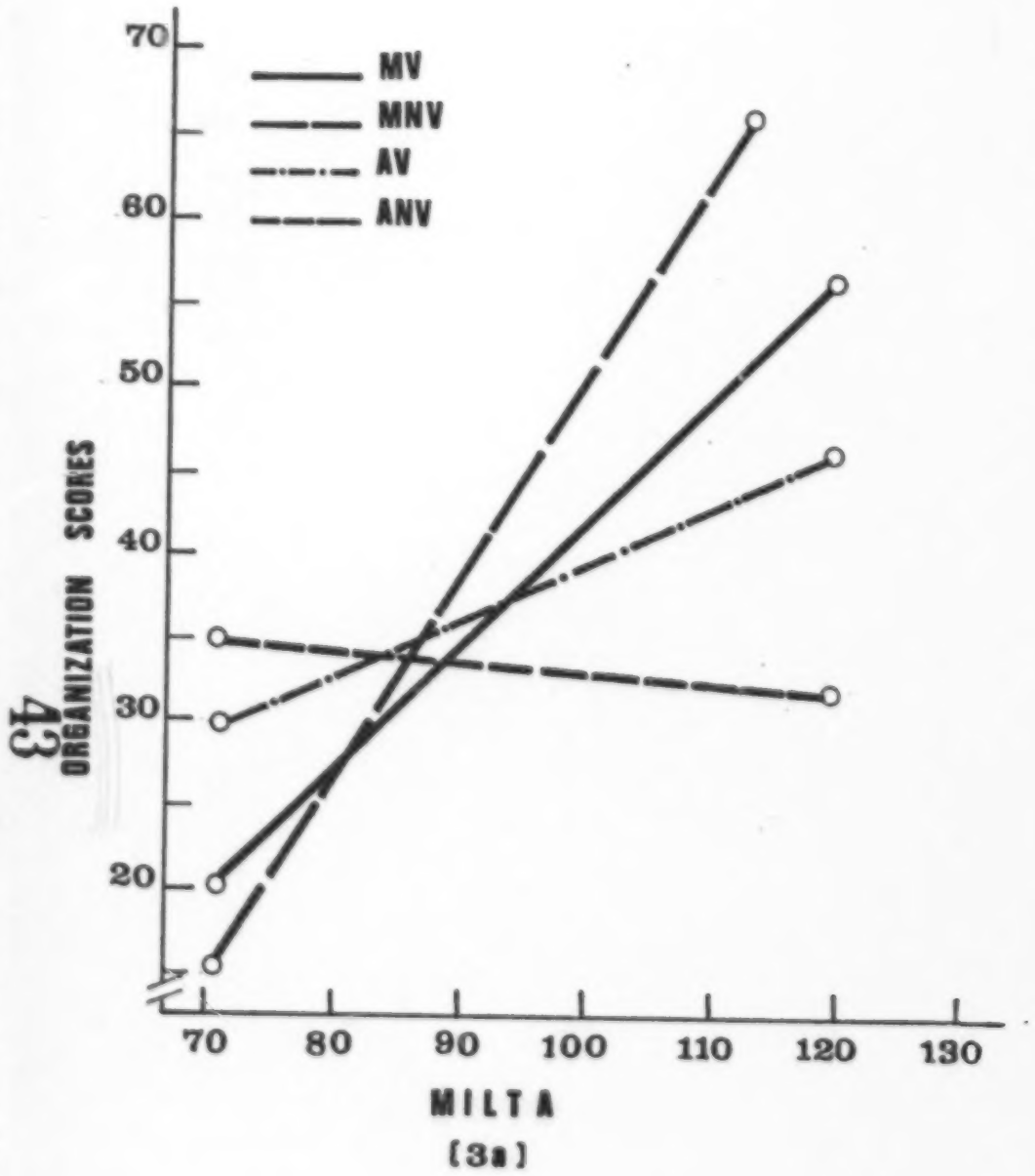

INFORMATION SEARCH
1
2
3
4
5
6
7
8
5
10
15
20
25
CA PRETEST SCORES
(1b)


MV
MNV
AV
ANV
DIFFERENTIATION POSTTEST SCORES
4
3
2
1
30
40
50
60
70
CA PRETEST SCORES

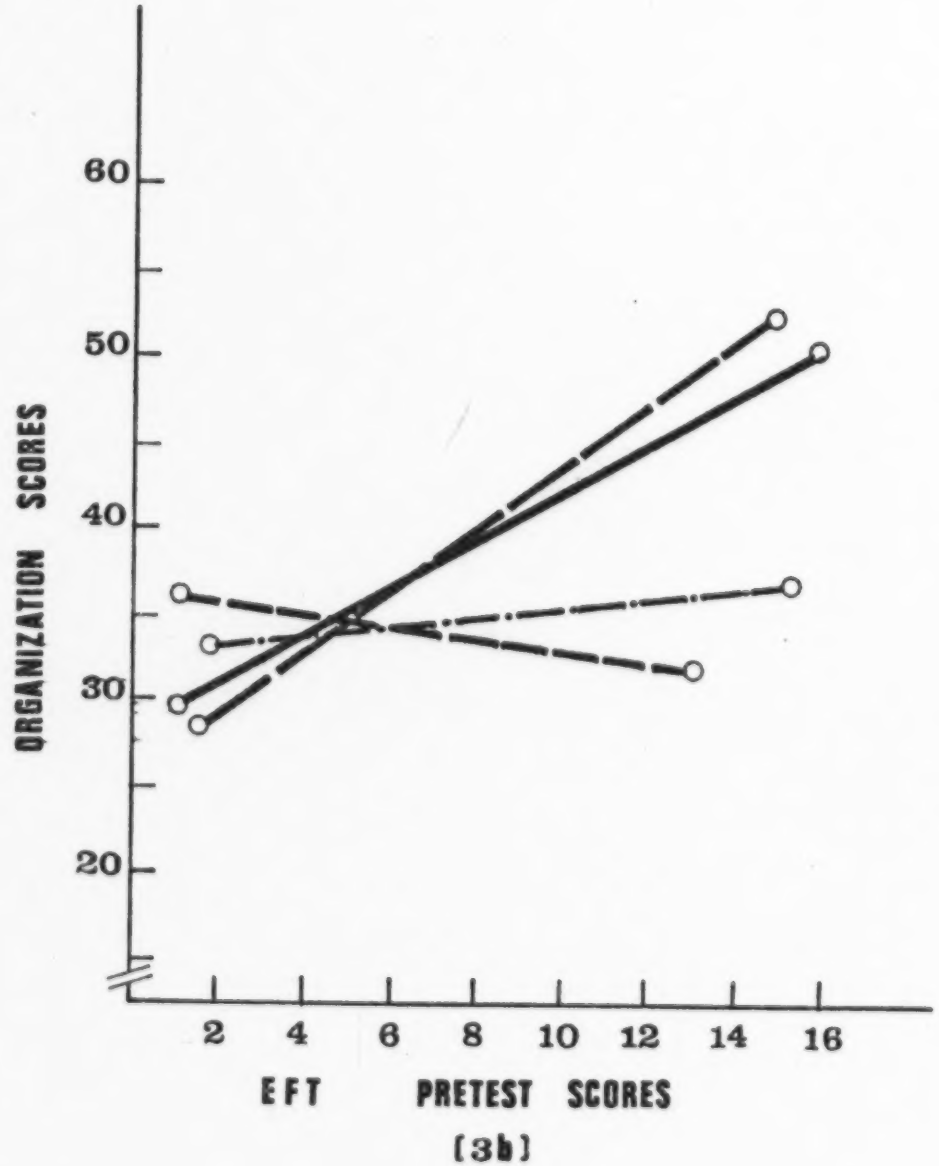
(2a)


CA POSTTEST SCORES
50
40
30
20
70
80
90
100
110
120
130
M I L T A

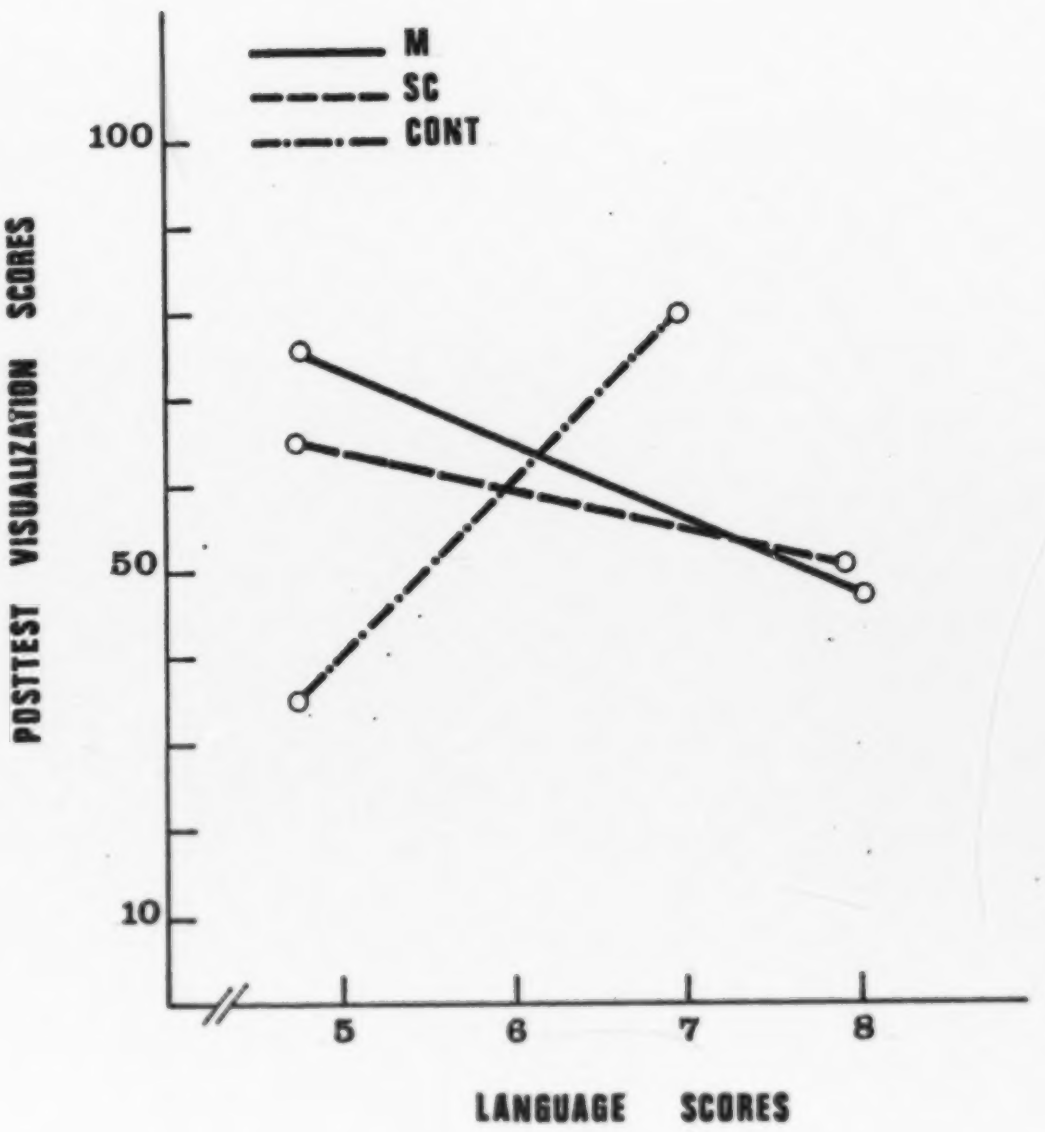
(2b)


MV
MNV
AV
ANV
70
60
50
40
30
20
ORGANIZATION SCORES
70
80
90
100
110
120
130
MILTA

(3a)


60
50
40
30
20
ORGANIZATION SCORES
2
4
6
8
10
12
14
16
EFT PRETEST SCORES

(3b)


M
SC
CONT
100
50
10
POSTTEST VISUALIZATION SCORES
5
6
7
8
LANGUAGE SCORES

Footnotes

[1] The research reported here was partly supported by a grant from the American Psychological Foundation and partly by the Israel Institute of Applied Social Research. The author is grateful to Michal Siman-Tov, Deborah Malveh and Avraham Cohen for their assistance in carrying out the experiments.

[2] Requests for reprints should be sent to: Gavriel Salomon, School of Education, The Hebrew University, Jerusalem, Israel

[3] More information pertaining to this measure can be found in Salomon & Sieber-Suppes (in press).